



Above: 36-inch Bell and Spigot VCP (10 ft. joints), Sioux City, IA

Vitrified Clay Resurgence

By Jeff Boschert, National Clay Pipe Institute

Vitrified Clay Pipe (VCP) is in the midst of a resurgence, both as the preferred material for open trench installations and as a new resource for trenchless installations of gravity sanitary sewers. There are several reasons for this resurgence, but the primary reason is that municipalities and engineers are confirming the long life and low maintenance of the product. As they have more experience with competitive products they evaluate what they have learned and opt to return to VCP both for what it has been for thousands of years and for what it has become: the best long-term value for sewer pipe.

After many years of competitive claims and competitive gains, engineers and maintenance departments are finding that the VCP in their systems outperforms and outlasts any competitive products. Municipalities are looking long and hard at the benefits that accrue to their communities and determining that the investment they make in the design and installation of their infrastructure demands the highest quality, longest lived product available.

In a paper presented at an ASCE Pipelines Conference, Terry Martin of Seattle Public Utilities estimated the life cycle of the clay pipe in Seattle's system to be between 300 and

400-years. The pipe in this system was installed from the late 1800s to just before 1940. This pipe didn't meet the production and quality control standards of today's product, yet the performance and durability realized in the system was instrumental in moving Seattle back to clay pipe.

Today's vitrified clay

An unmatched knowledge base built on more than 2,500 years of experience as the sewer material of choice is a resource only VCP can access. Much of the VCP in service in North America today was installed in the 1800s, prior to any standards for either the manufacture or installation of VCP. ASTM standards for VCP manufacture and installation were first introduced in the early 1900s. Today those standards have evolved to call for joints that "shall not leak," dependable rigid conduit three edge bearing strengths (varies with the size of pipe) and standard practices for design and installation.

While the basic principles of manufacturing clay pipe haven't changed, the controls and machinery have. There are two major differences in the pipe made today: laminations in the pipe body are nonexistent

due to the development of high densification extruding equipment and a consistent product due to computer controlled kiln-firing temperatures. VCP is manufactured from 100% natural materials – a blend of clays, shales, and slate. After this mix is blended and ground to a fine particle size, water is added and it is extruded, dried, and fired at temperatures reaching 2,000 degrees Fahrenheit (1,100 degrees Celsius) to achieve vitrification. Vitrified Clay is often confused with Terra Cotta, made in the early 1900s, which is fired at much lower temperatures resulting in a pipe with lower strengths.

The chemical resistance of VCP is unsurpassed by any other pipe material. The nature of the ceramic material prevents it from changing with age, compared to limited life products, which experience degradation over time. The longevity of clay pipe in conjunction with the jointing systems of modern clay delivers an unmatched service life. Today's clay pipe is available for open trench installations and trenchless installations.

The jacking (trenchless) pipes have a slightly thicker wall than the corresponding bell and spigot (open trench) pipe. In the manufacture of jacking pipe, a recess is ground into both ends of each pipe section to accept the sealing gasket and collar. Each section is done individually on a lathe with diamond cutting tools to





Jacking Pipe manufacturing



21-inch PTMT project, Edmonton, AB



42-inch Bell and Spigot VCP Extrusion

precision tolerances after the vitrification process. The pipe ends are cut square to allow the axial jacking force to be uniformly transmitted from the jacking frame through each succeeding pipe section.

Depending on the individual project conditions, a polyurethane, synthetic isoprene, EPDM, or nitrile elastomer can be used for the gasket material of the jacking pipe. Each compression joint is then coupled with a Series 316 stainless steel collar. Particleboard or chipboard compression rings, for axial load transfer during installation, are also supplied and used at each joint. Clay jacking pipe meets the specification requirements of ASTM C1208/C; 1208M and European Standard EN 295-7.

Today's clay pipe designed for open trench construction utilizes either a bell and spigot joint design with a factory applied elastomeric material or straight pipe barrels joined with rubber shear couplings and tightening bands. Similar to the jacking pipe, these joints are a 'leak free'

flexible compression fit when assembled. The advantages of utilizing a flexible type joint on a rigid conduit have been widely demonstrated since these joints were first introduced more than 50-years ago.

The basic engineering design of a conveyance system has changed over the years too. In 1930, 99% of systems in the US were designed to use dilution (now called I & I) as their treatment method. Back in that era, engineers considered infiltration and inflow to be a benefit to the system as the lines were flushed and cleaned during rain events. With the onset of wastewater treatment in the 1950s, I & I became undesirable due to increased treatment costs and the environmental impact of overflow events.

The National Clay Pipe Institute (NCPI) was instrumental in developing today's bedding systems. In the early 1900s the soil removed from the trench was placed back around the pipe by hand and carefully compacted. NCPI has tested materials, techniques and configurations to insure optimal support characteristics.

"We continue to develop new systems using today's materials, according to Mike Van Dine, President of NCPI. "One example is the use of Controlled Low Strength Material (CLSM) as a

bedding material for open trench installations. NCPI invested 12 years into researching and testing the best methods of formulation and use of CLSM and we are very excited about the increased load factors we've realized."

Trenchless installations

Vitrified Clay Jacking Pipe was introduced to the North American trenchless market in 1992. Since then it has been specified and used on over 200 tunneling projects of over 700,000 linear feet. This gravity flow, corrosion resistant sanitary sewer pipe has been used for pilot tube microtunneling, slurry microtunneling, static pipe bursting and as a carrier pipe inside a cased bore.

VCP Jacking Pipe is the predominant direct-jacked product pipe material used in the 8-inch thru 36-inch size range. In 3 or 6 foot lengths it is ideally suited for use with compact jacking frames and the small shaft sizes of pilot tube and slurry microtunneling installations. Tunnel equipment tooling is often sized to match the outside diameter and pipe lengths of VCP. In these installation processes, the greatest load the pipe will ever encounter is the axial force incurred during installation.



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100+-year-old pipe wall with laminations created when the pipe was manufactured



Modern day VCP pipe wall

The longest slurry microtunneling drive on record with the National Clay Pipe Institute was a single drive of 892 feet using 36" clay pipe completed in Sacramento County, California in 2009. This particular job is illustrative of the challenges that have driven the adoption of VCP in the trenchless industry with depths of up to 61-feet below grade and 40-feet below the existing ground water table.

VCP has also become more popular as the replacement pipe on static pipe-bursting projects. Because the pipe sections have compression fit joints and are designed to be 'jacked' during installation, a bursting system was designed to push each pipe joint 'home' as well as keep the

column of assembled pipe sections in compression during bursting.

This method of pipe-bursting keeps the jobsite footprint as well as shaft sizes relatively small and compact. Utilizing any segmented jacking pipe eliminates the need for a long lay-down area on the project site as would be required with welded or fused pipe. This is highly beneficial in high-traffic urban settings where long strings of joined pipe can be problematic. Inhibited traffic flow, blocked driveway access and local business disruption before and during the bursting operation can be minimized using this method.

A recent example of a pipe-bursting project using VCP was the Downtown Sewer Main

Replacement in Riverside, CA. This project replaced an existing 6" sanitary sewer line with a new 8" line to meet the needs of a growing community. A densely populated area required that the project footprint and the traffic disruption both be kept to a minimum.

The proven long-term option

Many US and Canadian cities have VCP sewer lines that are over 100-years old and are still in service today. These pipelines perform and continue to serve their communities, despite having been manufactured and installed with outdated construction practices and few recognized national standards.

Today's high tech VCP and VCP Jacking Pipe, newer construction practices, more sophisticated machinery and exacting production standards are all leading communities back to a rigid pipe with high compressive strength and an expected service life of over 200-years. 💧

About the author:

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